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## P SYSTEMS WITH ACTIVE MEMBRANES: ATTACKING NP-COMPLETE PROBLEMS<sup>1</sup>

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## ABSTRACT

P systems are parallel Molecular Computing models based on processing multisets of objects in cell-like membrane structures. Various variants were already shown to be computationally universal, equal in power to Turing machines. In this paper one proposes a class of P systems whose membranes are the main active components, in the sense that they directly mediate the evolution and the communication of objects. Moreover, the membranes can multiply themselves by division. We prove that this variant is not only computationally universal, but also able to solve NP-complete problems in polynomial (actually, linear) time. We exemplify this assertion with the well-known SAT problem.

Keywords: molecular computing, membrane systems, NP-complete problems, SAT.

## 1. Introduction: The Basic Variants of P Systems

The P systems are a class of distributed parallel computing devices of a biochemical type, introduced in [7], which can be seen as a general computing architecture where various types of objects can be processed by various operations.

Very shortly, in the basic model one considers a *membrane structure* consisting of several cell-like membranes which are hierarchically embedded in a main membrane, called the *skin* membrane. The membranes delimit *regions*, where we place *objects*.

The objects evolve according to given *evolution rules*, which are associated with the regions. A rule is applied to objects in the region with which it is associated and can modify the objects, send them outside the current membrane or to an inner membrane, and can also dissolve the membrane. When such an action takes place, all the objects of the dissolved membrane remain free in the membrane placed immediately outside, but the evolution rules of the dissolved membrane are removed. The skin membrane is never dissolved. Note that the membranes are both separators and channels of communication, but they are passive participants to the process, the whole functioning of the system is governed by the evolution rules.

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